Messrs. Whittaker and Co.'s announcements are:—"Experiments with Vacuum Tubes," by Sir David Salomons; "Hints to Automobilists," translated from the French of Baudry de Saunier by C. V. Biggs; "Practical Chemistry on the Heuristic Method," by Dr. W. C. Harris; "Elementary Practical Optics," by T. H. Blakesley; "Electric Traction," by J. H. Rider; "Electrical Engineers' Pocket-book," by Kenelm Edgcumbe; "Electric Lighting and Power Distribution," by W. Perren Maycock, vol. ii.; "Mechanical Refrigeration," by H. Williams; "Telephone Lines and Methods of constructing Them," by W. C. Owen; "Friction and its Reduction by Means of Oils, Bearings and Lubrication," by G. U. Wheeler.

THE BRITISH ASSOCIATION AT BELFAST.

SECTION H.

ANTHROPOLOGY.

OPENING ADDRESS BY A. C. HADDON, M.A., SC.D., F.R.S., M.R.I.A., PRESIDENT OF THE SECTION.

So much has been written of late on totemism that I feel some diffidence in burdening still further the literature of the subject. But I may plead a slight claim on your attention, as I happen to be an unworthy member of the Crocodile kin of the Western tribe of Torres Straits, and I have been recognised as such in another island than the one where I changed names with Maino, the chief of Tutu, and thereby became a member of his kin.

I do not intend to discuss the many theories about totemism, as this would occupy too much time; nor can I profess to be able to throw much light upon the problems connected with it; but I chiefly desire to place before you the main issues in as clear a manner as may be, and I venture to offer for your consideration one way in and some ways out of totemism.

A few years ago M. Marillier wrote ("Rev. de l'Hist. des Religions," xxxvi. 1897, pp. 368, 369), that "totemism is one of the rare forms of culture: it is incapable of evolution and transformation, and is intelligible only in its relations with certain types of social organisation. When these disappear it also disappears. Totemism in its complete development is antagonistic alike to transformation or progress." In due course I shall describe how one people at least is emerging from totemism. At the outset I wish it to be distinctly understood that I do not regard this as the only way out; doubtless there have been several transformations, but a record of what appears to be taking place appeals more to most students than a guess as to what may have happened.

What is most needed at the present time is fresh investigation in the field. Those who are familiar with the literature of the subject are only too well aware of the imperfection of the available records. There are several reasons which account for this. Some of the customs and beliefs associated with totemism have a sacred significance, and the average savage is too reverent to speak lightly of what touches him so deeply. Natives cannot explain their mysteries any more than the adherents of more civilised religions can fully explain theirs. Further, they particularly dislike the unsympathetic attitude of most inquirers, and nothing shuts up a native more effectually than the fear of ridicule.

Language is another difficulty. Even supposing the white man has acquired the language, the vocabulary of the native is not sufficiently full or precise to explain those distinctions which appeal to us, but which are immaterial to him.

Granting the willingness of the native to communicate his ideas, and that the hindrance of language has been overcome, there remains the difficulty of the native understanding what it is the white man wishes to learn. If there is a practically insuperable difficulty in the investigator putting himself into the mental attitude of the savage, there is also the reciprocal source of error.

> "Oh, East is East, and West is West,
> And never the twain shall meet."

If Kipling is right for the civilised Oriental, how about those of lower stages of culture and more primitive modes of thought?

We must not overlook the fact that the majority of white men who mix with primitive folk are either untrained observers or their training is such that it renders them yet more unsympathetic —one might say antagonistic—to the native point of view. The ignorance and prejudice of the white man are great hindrances to the understanding of native thought.

When students at home sift, tabulate and compare the available records they get a wider view of the problems concerned than the investigator in the field is apt to attain. Generalisations and suggestions crystallise out which may or may not be true, but which require further evidence to test them. So the student asks for fresh observations and sends the investigator back to his field.

The term "totemic" has been used to cover so many customs and beliefs that it is necessary to define the connotation which is here employed.

It appears from Major J. W. Powell's recent account of totemism (*Man*, 1902, No. 75) that the Algonkin use of the term "totem" is so wide as to include the representation of the animal that is honoured (but he does not state that the animal itself is called a totem), the clay with which the person was painted, the name of the clan,[1] and that of the gens,[2] the tribal name, the names of shamanistic societies, the new name assumed at puberty, as well as the name of the object from which the individual named. He distinctly states, "We use the term 'totemism' to signify the system and doctrine of naming." I must confess to feeling a little bewildered by this terminology, and I venture to think it will not prove of much service in advancing our knowledge. It looks as if there had been some misunderstanding, or that the Algonkins employed the word "totem" to cover several different ideas because they had not definite terms with which to express them. Major Powell's definitions practically exclude those cults which are practised in various parts of the world, and which by the common consent of other writers are described as totemic.

Prof. E. B. Tylor has given (*Man*, 1902, No. 1; *cf. Journ.* Anthrop. Inst., xxviii. 1898, p. 138) the following clear exposition of his interpretation of the American evidence: "It is a pity that the word 'totem' came over to Europe from the Ojibwas through an English interpreter who was so ignorant as to confuse it with the Indian hunter's patron genius, his *manitu*, or 'medicine.' The one is no more like the other than a coat of arms is like a saint's picture. Those who knew the Algonkin tribes better made it clear that totems were the animal signs, or, as it were, crests, distinguishing exogamous clans; that is, clans bound to marry out of, not into, their own clan. But the original sin of the mistake of Long the interpreter has held on ever since, bringing the intelligible institution of the totem clan into such confusion that it has become possible to write about 'sex totems' and 'individual totems,' each of which terms is a self-contradiction. . . . Totems are the signs of intermarrying clans."

A reviewer in "L'Année Sociologique," ii. 1899, says (p. 202): "One must avoid giving to a genus the name of a species. It will be said these are merely verbal quibbles; but does not the progress of a science consist in the improvement of its nomenclature and in the classification of its concepts?"

Totemism, as Dr. Frazer and as I understand it, in its fully developed condition implies the division of a people into several totem kins (or, as they are usually termed, totem clans), each of which has one, or sometimes more than one, totem. The totem is usually a species of animal, sometimes a species of plant occasionally a natural object or phenomenon, very rarely a manufactured object. Totemism also involves the rule of exogamy, forbidding marriage within the kin, and necessitating intermarriage between the kins. It is essentially connected with the matriarchal stage of culture (mother-right), though it passes over into the patriarchal stage (father-right). The totems are regarded as kinsfolk and protectors or benefactors of the kinsmen, who respect them and abstain from killing and eating them. There is thus a recognition of mutual rights and obligations between the members of the kin and their totem. The totem is the crest, or symbol of the kin.

Sometimes all the kins are classified into two or more groups; for example, in Mabuiag, in Torres Straits, there is a dual grouping of the kins, the totems of which are respectively land and water animals; and in speaking of the latter group my informant volunteered the remark, "They all belong to the water; they are all friends." On the mainland of New Guinea also I found that one group of the totems "stop ashore," while the other "stop in water." When no member of a group of kins in a community can marry another member of that same group, that group is termed a phratry. An Australian tribe is generally divided into two exogamous phratries.

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[1] A group that reckons descent only through the mother.

[2] A group that reckons descent only through the father.

North America is the home of the term "totem," and though typical totemism does occur there, it is often modified by other customs. In Australia we find true totemism rampant, and it occurs in Africa, where also it is subject to much modification. Quite recently the Rev. J. Roscoe has published an important paper (*Journ.* Anthrop. Inst., xxxii. 1902, p. 25) on the Baganda, in which he describes a perfectly typical case of totemism. Among the Baganda there are a number of kins each of which has a totem, *muziro*. The kin, *kika*, is called after its totem; no member of a kin may kill or eat his totem, though one of another kin may do so with impunity. No one mentions his totem. Old people affirm their fathers found some things injurious to them either as food or to their personal safety, and made their children promise not to kill or eat that particular thing. No man may marry into his mother's kin, because all the members of it are looked upon as sisters of his mother; nor may he marry into his father's kin except in the case of two very large kins. In Uganda, royalty follows the totem of the mother, whilst the common people follow the paternal totem. Each kin has its own special part of the country where the dead are always buried. For sympathy or assistance the member of a kin always turns to his particular kin. From what Mr. Roscoe says about the married women of the Green Locust kin, it is evident that the magical aspect of totemism is present as it is in Australia and Torres Straits. The Baganda are thus a true totemic people who are in an interesting transitional condition between matriarchy and patriarchy. Totemic practices also occur in various parts of Asia.

To put the matter briefly, totemism consists of the following five elements:—

(1) Social organisation with totem kinsmen and totem symbols.
(2) Reciprocal responsibilities between the kin and the totem.
(3) Magical increase[1] or repression of the totem by the kinsmen.
(4) Social duties of the kinsmen.
(5) Myths of explanation.

Totemism is only one of several animal cults, and it is now necessary to consider certain cults that have been termed totemic before I proceed with the main object of this Address.

Manitu (*Guardian Spirit*).

Very widely spread in North America was the belief in guardian spirits which appeared to young men in visions after prayer and fasting. It then became the duty of the youth to seek until he should find the animal he had seen in his trance; when found he must slay and preserve some part of it. In cases when the vision had been of no concrete form, a symbol was taken to represent it: this memento was ever after to be the sign of his vision, the most sacred thing he could ever possess, for by it his natural powers were so to be reinforced as to give him success as a hunter, victory as a warrior, and even power to see into the future.

The guardian spirit was obtained in various ways by different American tribes, but the dream apparition was the most widely spread. Dr. Frazer ("Totemism," 1887, pp. 2, 53) calls it "individual totem"; Miss Fletcher speaks of the object dreamed of (the *wahube* of the Omaha) as the "personal totem" or simply as the "totem"; it is termed by the Algonkin *manitu*, by the Huron *okki*, by the Salish Indians *sulia*, and *nagual* in Mexico. Perhaps it would be best to adopt either *wahube* or *manitu* to express the guardian spirit.

Miss Alice C. Fletcher finds that among the Omaha ("The Import of the Totem," Amer. Assoc. Adv. Sci., Detroit Meeting, August, 1897) those who have received similar visions, that is, those who have the same *wahube*, formed brotherhoods which gradually developed a classified membership with initiatory rites and other rituals. These religious societies acquired great power; still later, according to this observer, an artificial social structure, the "gens," was organised on the lines of the earlier religious societies. Each "gens" had its particular name, which referred directly or symbolically to its totem, and its members practised exogamy and traced their descent only through the father. "As totems could be obtained in but one way—through the rite of vision—the totem of a 'gens' must have come into existence in that manner, and must have represented the manifestation of an ancestor's vision, that of a man whose ability and opportunity served to make him the founder of a family." Mr. C. Hill-Tout (*Trans.* Roy. Soc. Canada, 2nd ser., vii., sect. 2, 1901, p. 6), in discussing the origin of the totemism of the aborigines of British Columbia, states: "There is little room for doubt that our clan totems are a development of the personal or individual totem or tutelar spirit, as this is in turn a development of an earlier fetishism."

Dr. F. Boas points out ("Report U.S. Nat. Mus.," 1895 (1897), pp. 322, 323, 334) that the tribes of the northern portion of the North Pacific group of peoples, such as the Tlingit, Haida and Tsimshian, have a maternal organisation with animal totems; the clans bear the names of their respective totems and are exogamous. The central tribes, particularly the Kwakiutl, show a peculiar transitional stage. The southern tribes have a purely paternal organisation, and their groups are simple village communities which are often exogamic.

Dr. Boas distinctly asserts (*l.c.*, p. 323) that "the natives do not consider themselves descendants of the totems; all endeavours to obtain information regarding the supposed origin of the relation between man and animal invariably led to the telling of a myth in which it is stated how a certain ancestor of the clan in question obtained his totem. . . . It is evident that legends of this character correspond almost exactly to the tales of the acquisition of manitows among the eastern Indians, and they are evidence that the totem of this group of tribes is in the main the hereditary manitow of a family.[1] This analogy becomes still clearer when we consider that each man among these tribes acquires a guardian spirit, but that he can acquire only such as belong to his clan. Thus a person may have the general crest of his clan, and besides use as his personal crest such guardian spirits as he has acquired. This accounts partly for the great multiplicity of combinations of crests on the carvings of these people."

Throughout a considerable portion of North America there appears to be a mixture of variously developed cults of the totem and of the *manitu*. It is not perhaps possible at present to dogmatise as to the relative chronology of these two cults. Personally I am in favour of the superior antiquity of the totem cult, as the conception of an individual spirit-helper appears to me to be of a higher grade than the ideas generally expressed by purely totemic peoples, or what may be gathered by implication from a study of their ceremonies.

The social organisation appears to be very weak in some Californian tribes; our knowledge of the Seri in this respect is very meagre, but Dr. Dixon definitely denies (*Bull.* Amer. Mus. Nat. Hist., xvii., pt. 2, 1902, p. 35) the existence of totemic grouping among the Maidu.

Accepting then for the present the priority of the totem cult, we find a substratum of totemism underlying many of the social organisations in North America. Religious societies are a noticeable feature of the social life of North-west America; those societies have the guardian spirit (*manitu*) as their central idea, but it appears as if the organisation is rooted in a clan (matriarchal totemic kin) system which has been smothered and virtually destroyed by the parasitic growth. The problems to be solved in North-west America are very complicated, and we must await with patience further researches. It is perfectly evident from the researches of Boas, Nelson, Hill-Tout and others that comparatively recent great changes have taken place. Dr. Boas indeed states that "the present system of tribes and clans (of the Kwakiutl) is of recent growth and has undergone considerable changes" (*l.c.*, p. 333). An interesting illustration of this is found in the alteration in the organisation of the (Kwakiutl) tribe during the season of the winter ceremonial. "During this period the place of the clans is taken by a number of societies, namely, the groups of all those individuals upon whom the same or almost the same power or secret has been bestowed by one of the spirits" (*l.c.*, p. 418). The characteristic North

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[1] The first intimation of this aspect of totemism is entirely due to the researches of Messrs. Spencer and Gillen ("The Native Tribes of Central Australia," 1899). Dr. J. G. Frazer, appreciating the value of these observations, extended the conception to totemism generally, *Journ.* Anthrop. Inst., xxviii. 1899, p. 285, read December 14, 1898; the *Fortnightly Review*, April, 1899, pp. 664, 665; *cf.* also "Israel and Totemism," by S. A. Cook, *Jewish Quart. Review*, April, 1902, pp. 25, 26 of reprint.

[1] But Mr. E. S. Hartland points out ("Folk-lore," xi. 1900, p. 61) that we have clear evidence from the legends of the descent at all events of some of the clans from non-human ancestors; and Mr. Hill-Tout says: "Among the Salish tribes it is uniformly believed that in the early days, before the time of the tribal heroes or great transformers, the beings who then inhabited the world partook of the character of both men and animals, assuming the form of either apparently at will."

American idea of the acquisition of the *manitu* was evidently also fundamental among the Kwakiutl, as all their tales refer to it and the whole winter ceremonial is based on it.

I agree in the main with Mr. Hartland ("Folk-lore," xi. p. 68) in thinking that, "whether or no totemism was anciently a part of the tribal organisation, the *manitu* conception is of modern date. It is part of the individualism which is tending, not among these tribes only, to obscure the older communistic traditions."

Nyarong.

Allied to the *manitu* of North America is the *nyarong*, or spirit-helper, of the Iban (Sea Dayaks) of Sarawak. The Iban believe that the spirit of some ancestor or dead relative may come to them in a dream, and this *nyarong* becomes the special protector of the individual. An Iban youth will often retire to some lonely spot or mountain-top and live for days on a very restricted diet in his anxiety to obtain a vision. This custom is called *mampok*. On the following day the dreamer searches for the outward and visible form of the *nyarong*, which may be anything from a curious natural object to some one animal. In such cases the *nyarong* hardly differs from a fetish. In other cases, as the man is unable to distinguish the particular animal which he believes to be animated by his *nyarong*, he extends his regard and gratitude to the whole species. In some instances all the members of a man's family and all his immediate descendants, and if he be a chief all the members of the community over which he rules, may came to share the benefits conferred by the *nyarong* and pay respect to the species of animal in one individual of which it is supposed to reside. "In such cases," Drs. Hose and McDougall remark (*Journ.* Anthrop. Inst., xxxi. 1901, p. 210), "the species approaches very closely the clan totem in some of its varieties." Here we have a parallel to the North American custom, but the later stages are not carried as far.

Personally I concur in the opinion expressed by Drs. Hose and McDougall that there is no proof that the peculiar regard paid in Sarawak to animals, the sacrifice of animals to gods or spirits, the ceremonial use of the blood of these sacrificed animals are survivals of a fully developed system of totem worship now fallen into decay. It is very significant that the magical and social aspects of totemism are entirely lacking.

Those who have read Miss Alice Fletcher's sympathetic account of "The Import of the Totem" (Amer. Assoc. Adv. Sci., Section Anthropology, Detroit Meeting, August, 1897) can scarcely fail to recognise that the moral support due to a belief in the guidance and protection of a *wahube* ("personal totem") is of great importance to the individual, and would nerve him in difficulty and danger, and thus proving a very present help in time of need it would surely justify its existence in a most practical manner and consequently be of real utility in the struggle for existence—a struggle which in man has a psychical as well as a material aspect.

The advantages of totemism are many, but most of them are social and benefit the special groups or the community at large. The hold that the *manitu* has on the individual consists in its personal relation; the man feels that he himself is helped, and I suspect this is the main reason why it supplants totemism. I believe Mr. Lang some years ago suggested the term *manituism* for this cult. If this name be not accepted I venture to propose the revival of the word "daimon" (δαίμων) to include the *manitu*, *nyarong* and similar spirit-helpers, and "daimonism" as the name of the cult.

Theriomorphic Ancestor Worship.

Dr. Frazer calls attention (*Man*, 1901, No. 3) to a publication by Dr. G. McCall Theal ("Records of South-eastern Africa," vii. 1901) in which he describes the tribal veneration for certain animals, *siboko*. The Bantu believed that the spirits of the dead visited their friends and descendants in the form of animals. Each tribe regarded some particular animal as the one selected by the ghost of its kindred, and therefore looked upon it as sacred. Dr. Frazer says: "Thus the totemism of the Bantu tribes of South Africa resolves itself into a particular species of the worship of the dead; the totem animals are revered as incarnations of the souls of dead ancestors. This entirely agrees with the general theory of totemism suggested by the late S. G. A. Wilken and recently advocated by Prof. E. B. Tylor" (*Journ.* Anthrop. Inst., xxviii. p. 146). But is this totemism? The *siboko* are the residences of the ancestral spirits of the tribe, not of a clan; there is no mention of *siboko* exogamy. Is this anything more than theriomorphic ancestor worship? There can, however, be little doubt that true totemism did occur, and probably universally so, among the Bantu people; but some of the tribes appear to be in a transitional state, and others have doubtless passed beyond typical totemism. The decay of the Bantu totemism in South Africa appears to have been mainly due to a patriarchal organisation combined with a pastoral life.[1]

In describing Dr. Wilken's theory that the doctrine of the transmigration of souls affords the link which connects totemism with ancestor worship, Prof. Tylor concludes as follows: "By thus finding in the world-wide doctrine of soul-transference an actual cause producing the two collateral lines of man and beast which constitute the necessary framework of totemism, we seem to reach at least something analogous to its real cause." I have already expressed my belief that the animal cults of the Malay Archipelago, so far as they are known at present, cannot be logically described as totemism, and the majority of the peoples of this area have so long passed out of savagery that we are hardly likely to find here an unequivocal clue to the actual origin of totemism.

The reverence paid to particular animals or plants by certain groups of people in Fiji may, as Mr. Lorimer Fison says, ("Ann. Rep. Brit. New Guinea," 1897-98, p. 136) "look like reminiscences" of totemism, but he has "no direct evidence." It surely belongs to the same category as the Samoan custom of which Dr. George Brown writes (*ibid.*, p. 137), "In Samoa every principal family had some animal which they did not eat, and I have always regarded this as meaning, not that they thought the animal divine, or an object of worship, but that it was the 'shrine' in which their ancestral god had dwelt, or which was associated with some fact in their past history which had led them to adopt it as their totem." An opinion which Prof. Tylor has independently expressed (*Journ.* Anthrop. Inst., xxviii. p. 142), but he naturally dissents from the incarnate god being termed a "totem."

I agree with Dr. Codrington ("The Melanesians," 1891, p. 32) in doubting whether the evidence warrants a belief in totemism as an existing institution in the Southern Solomon Islands. I suspect that totemism has been destroyed over a considerable portion of Melanesia by the growth of secret societies as well as by theriomorphic ancestor worship. Herr R. Parkinson (*Abh. Ber. k Zool. Anth. Eth. Mus. Dresden*, vii. 1899, Nr. 6); however, proves true totemism in the Northern Solomon Islands as the Rev. B. Danks had previously done (*Journ.* Anthrop. Inst., xviii. 1889, p. 281) for New Britain, Duke of York Island and New Ireland.

The more one looks into the evidence the more difficult is it to find cases of typical totemism; almost everywhere considerable modification has taken place, often so much so that the communities cannot logically be called totemistic. The magical increase of the totem by the clansmen does not appear to be common, but that may be due to its having been overlooked; on the other hand, magic may be performed against the totems to prevent them from injuring the crops, as in the case of the "Reptile people" of the Omaha (J. O. Dorsey, "Ann. Rep. Bureau Ethnol.," 1881-82 (1884), p. 248).

Animal Brethren.

Throughout South-eastern Australia and probably elsewhere in that continent, there is a peculiar association of a species of animal, unusually a bird, with each sex. To take two examples given by Mr. A. W. Howitt (*Journ.* Anthrop. Inst., xv. 1886, p. 416), "the bird totems of the Kurnai are the Emu, Wren and the Superb Warbler, which are respectively the 'man's brother' and 'woman's sister.' . . . When we turn to the Kulin, we find both the Kurnai totems in just the same position. In addition there are also a second male and female totem, namely, the Bat and the small Night Jar." Mr. Howitt is careful to point out, "They are not true totems in the sense that these represent subdivisions of the primary classes; yet they are true totems in so far that they are regarded as being the 'brothers' and 'sisters' of the human beings who bear their names." Mr. A. L. P. Cameron (*ibid.*, xiv. 1885, p. 350) also states that these are "something different from ordinary totems." Later Mr. Howitt (*ibid.*, xviii. 1888, pp. 57, 59) says: "Among the Wotjobaluk tribe which have a true totemic system these were real totems although of a peculiar kind. They were called *yaur*, or 'flesh,' or *ngirabŭl*, or *mir*, just as were the totems proper. The only difference was that the Bat was the brother of all the men, while any one totem was the brother only of the men who bore it as their totem. . . . It is evident that the institution of the 'man's brother' and the 'woman's sister' as totems is very widespread throughout Australia. I have traced it over an extent of about a thousand miles and in tribes having marked differences in language and in social organisation. It seems to be very persistent and enduring, for it remained among the Kurnai in full force after the ordinary social organisation in class divisions and totems had become extinct." Mr. Howitt speaks of these as "abnormal totems," and Dr. Frazer ("Totemism," p. 51; "The Golden Bough," iii. p. 416) calls them "sex totems." As it appears most desirable to distinguish between this cult, which is confined to Australia, and true totemism, I propose, in default of a distinctive native term, to call these reverenced animals "animal brethren." Although the natives do not appear to distinguish nominally between these animal brethren and ordinary totems, it does not follow they are to be considered as the same. I am calling attention to an analogous confusion of terms in the totemism of Torres Straits.

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[1] E. Durkheim, "L'Année Sociologique," v. 1902, p. 330; *cf.* also F. B. Jevons, "Introduction to the History of Religion," 1902, pp. 155, 158.

I must now pass on to a further consideration of true totemism as understood by Tylor, Frazer, Lang, Hartland, Jevons, Durkheim and others, as it is impossible within the limits of an Address to give an account of all the varieties of pseudo-totemism.

A Suggestion concerning the Origin of Totemism.

I take this opportunity to hazard a suggestion for a possible origin of one aspect of totemism. Primitive human groups, judging from analogy, could never have been large, and the individuals comprising each group must have been closely related. In favourable areas each group would have a tendency to occupy a restricted range owing to the disagreeable results which arose from encroaching on the territory over which another group wandered. Thus it would inevitably come about that a certain animal or plant, or group of animals or plants, would be more abundant in the territory of one group than in that of another. To take a clear example, the shore-folk and the river-folk would live mainly on different food from each other and both would have other specialities than fell to the lot of the jungle-folk. The groups that lived on the seashore would doubtless have some natural vegetable products to supplement their animal diet, but the supply would probably be limited alike in quantity and variety. Even they would scarcely have unlimited range of a shore line, and there would be one group of shore-folk that had a speciality in crabs, another would have shell-beds, while a third would own sandy shores which were frequented by turtle. A similar natural grouping would occur among the jungle-folk; sago flourishes in swampy land, certain animals frequent grassy plains, others inhabit the dense scrub, bamboos grow in one locality, various kinds of fruit trees thrive best in different soils; the coastal plains, the foot hills, the mountains, each has its characteristic flora and fauna. There is thus no difficulty in accounting for numerous small human groups each of which would be largely dependent upon a distinctive food supply the superfluity of which could be bartered [1] for the superfluities of other groups. These specialities were not confined to food alone; for example, the shore-folk would exchange the shells they collected for the feathers obtained from the jungle-folk.

It may be objected that in the great prairies and steppes of America, Eurasia and Australia the natural products are very uniform; but these areas are not thickly populated, and in most cases they probably were only inhabited when the pressure of population in the localities with more varied features forced migration into the open. Certainly these were never the primitive homes of man.

In a recent paper read before the Folklore Society, Mr. Andrew Lang put forward the hypothesis that while each primitive human group called itself "the men," they named the surrounding groups from the names of animals or plants, and hence arose totemism. The idea that there was an intimate connection between the group and the object from which they were nicknamed would soon be developed, and myths of origin would spring up to account for the name. Mr. Lang's theory, still unpublished, regards totem names as given from without for a variety of reasons, amongst which, I understand, he includes my own suggestion. His conjecture is based on the similar names, or sobriquets, of villages in the folklore, or *blason populaire*, of France and England, which, again, is almost identical with the extant names of Red Indian totem kindred now counting descent in the male line. Similar phenomena occur in Melanesia with female kin. Mr. Lang is rather indifferent to the causes of the name-giving so long as the name-giving comes from without and applies to groups, not to individuals.

To return to my suggestion. Among the shore-folk the group that lived mainly on crabs and occasionally traded in crabs might well be spoken of as the "crab-men" by all the groups with whom they came in direct or indirect contact. The same would hold good for the group that dealt in clams or in turtle, and reciprocally there might be sago-men, bamboo-men, and so forth. It is obvious that men who persistently collected or hunted a particular group of animals would understand the habits of those animals better than other people, and a personal regard for these animals would naturally arise. Thus from the very beginning there would be a distinct relationship between a group of individuals and a group of animals or plants, a relationship that primitively was based, not on even the most elementary of psychic concepts, but on the most deeply seated and urgent of human claims, hunger.

There is scarcely any need to point out that the association of human groups with fearsome animals would arise by analogy very early. Hence tiger-men and crocodile-men would restrain the ravages of those beasts (Dr. Frazer, *Fortnightly Review*, 1899, p. 835, describes this as the negative or remedial side of totemic magic); but I take it this was not as primitive as the nutritive alliances. The relation between groups of men and the elements has a purely economic basis; for example, rain is rarely required for itself, but as a means for the increase of vegetable food; similarly the fisherman wants a wind to enable him to get to and from his fishing grounds.

The next phase is reached when man arrived at elementary metaphysical conceptions and endeavoured by sympathetic or symbolic magic to increase his food supply. Naturally the food or product that each group would endeavour to multiply would be the speciality or specialities of that group, and for this practice we now have demonstrative evidence. Though this may be an early phase of totemism, I do not consider it the earliest; it can scarcely be the origin of totemism, but it doubtless helped to establish and organise the system.

The essential difference between the view advocated by Dr. Frazer (*loc. cit.*, 1899, p. 835) and that here suggested is that according to him totemism "is primarily an organised and cooperative system of magic designed to secure for the members of the community, on the one hand, a plentiful supply of all the commodities of which they stand in need, and, on the other hand, immunity from all the perils and dangers to which man is exposed in his struggle with nature. Each totem group, on this theory, was charged with the superintendence and control of some department of nature from which it took its name, and with which it sought, as far as possible, to identify itself." Whereas I suggest that the association between a group of men and a species of animals or plants was the natural result of local causes, and that departments of nature were not "assigned to a particular group" of men. I think it is scarcely probable "that in very ancient times communities of men should have organised themselves more or less deliberately for the purpose of attaining objects so natural by means that seemed to them so simple and easy." I suspect that if there was any deliberate organisation it was in order to regulate already existing practices.

To us it might appear that these magical practices could be undertaken by anyone, but this does not seem to have been an early conception. As far as we can penetrate the mind of existing backward man, there is a definite acknowledgment of the limit of his own powers. The members of one group can perform a certain number of actions; there are others that they cannot undertake. One group of men, for example, may ensure the abundance of a certain kind of animal, but another will have power over the rain. An interesting example of this limitation is afforded at Port Moresby, in British New Guinea, where the Motu immigrants have to buy fine weather for their trading voyages from the sorcerers of the indigenous agricultural Koitapu (J. Chalmers, "Pioneering in New Guinea," 1887, p. 14).

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[1] It may be objected that the idea of barter is by no means primitive; but as I believe that sociability was a fundamental characteristic of primitive man I can see no reason why it should not have occurred quite early in a rudimentary sort of way.

The remarkable researches of Messrs. Spencer and Gillen in Central Australia prove that it is the function of the kinsmen of a particular totem to perform what are known as *intichiuma* ceremonies, the object of which is to cause the abundance of the species of animal or plant which is the totem of that kin. The descriptions of these ceremonies are well known to students.[1] I have adduced further evidence of a like nature,[2] and from what Mr. Roscoe has found in Uganda we may expect other examples from Africa.

It may be that in some, possibly in all, of the instances of sympathetic and symbolic magic there is a belief that wind or sun, animal or plant, or whatever the objects may be, are animated by spirits akin to those of humankind; but even so, as Dr. Frazer[3] points out, the action of the magician is a direct one; it does not imply the assistance of other powers who can control the body or spirit of those objects. The data from Australia and Torres Straits point to the conclusion that there is a magical aspect of totemism, which is of great economic importance, and there is no evidence that the officiators at these ceremonies acknowledge the assistance of spiritual powers resident either within the objects themselves or in the form of independent, more or less supreme beings. The existing data do not deny their existence, they simply ignore them in the ceremonies, and so far they are practically non-existent.

According to the suggestion I have ventured to make, the primitive totemic groups ate their associated animals or plants; indeed, these were their chief articles of diet. Messrs. Spencer and Gillen point out[4] that while amongst most Australian tribes a man may not eat his totem, amongst the Arunta and other tribes in the centre of the continent there is no restriction according to which a man is altogether forbidden to eat his totem. On the other hand, though he may, only under ordinary circumstances, eat very sparingly of it, there are certain special occasions on which he is obliged by custom to eat a small portion of it, or otherwise the supply would fail. The Arunta are a peculiar people, while they may be primitive in some respects; in others they are not so, as also has been pointed out by Durkheim ("L'Année Sociologique," v. 1902). According to the strict definition of the term, they are not even a totemic people. Judging from the evidence of the legends of the Alcheringa time and the traces of group marriage and mother right, Mr. Hartland ("Folk-lore," xi. 1900, pp. 73–75) is of opinion that the present disregard by the Arunta of the totem in marriage is a stage in the sloughing of totemism altogether, whereas the *engwura*, or final initiation ceremonies, indicate that the organisation is undergoing a slow transformation into something more like the so-called secret societies of the British Columbian tribes."

The eating of what are evidently the totem animals by the Arunta may possibly be a persistence from an earlier phase, but, without doubt, the totem taboo is characteristic of totemism in full sway.[5] We have evidence to show that under certain conditions the totem taboo may break down, but this is a later transformation, and indicates a breaking up of the rigid observance of totemism.

Mr. Lang ("Magic and Religion," 1901, pp. 264, 265) has made a simple suggestion to account for the origin of the totem taboo. He says: "These men therefore would work the magic for propagating their kindred in the animal and vegetable world. But the existence of this connection would also suggest that, in common decency, a man should not kill and eat his animal or vegetable relations. In most parts of the world he abstains from this uncousinly behaviour; among the Arunta he may eat sparingly of his totem, and must do so at the end of the close-time or beginning of the season. He thus, as a near relation of the actual kangaroo or grubs, declares the season is open, now his neighbours may begin to eat grubs or kangaroos; the taboo is off." Dr. Frazer puts forth two suggestions (*Fortnightly Review*, 1899, pp. 838–40): the one is that as animals do not eat their own kind, so man thought it inconsistent to eat his totem kin; the other is a hypothetical idea of conciliation.

I have barely touched upon the relation of social organisation, with its marriage taboo, to totemism. It is by no means certain that the social regulations and customs, which are so much in evidence in a fully developed totemic society, were primitively connected with totemism. So far as the Arunta are concerned, Messrs. Spencer and Gillen believe (*Journ.* Anthrop. Inst., xxviii. 1899, pp. 277, 278) the "totemism appears to be a primary, and exogamy a secondary, feature . . . and that exogamic groups were deliberately introduced so as to regulate marital relations." But is this primitive?

If one admits that mankind was originally distributed in small groups, which must have consisted of near kin, it does not seem difficult to imagine that marriage would more likely take place between members of contiguous groups rather than within the groups themselves. The attraction for novelty must always have operated, and in the struggle for existence there was always one advantage to be gained by alliances between neighbouring groups, not only from a commissariat point of view, but for offensive and defensive purposes. There is, of course, the converse of this, as wife-stealing would lead to feuds; perhaps daughter-abduction was more frequent, and this probably was not regarded as an offence so serious that a mild scrimmage would not set matters right. It would not take long for wont to crystallise into rigid custom, and custom is always supported by public opinion.

Social regulations must be later than social conditions, and I suspect that the privileges and taboos which run through the social aspect of totemism first arose when totemic groups were in process of aggregation into more complex communities, and afterwards gradually became fixed into a system.

Hero-cults.

The facts to which I have hitherto directed your attention fall well within the sphere of totemism, but I wish now to indicate two interesting departures from typical totemism, both of which occur among the Western tribe of Torres Straits.

I have alluded to the dual grouping of the totem kins at Mabuiag, and an analogous arrangement occurred in the other islands; I propose to speak of each group of kins as a phratry. Strictly speaking, a phratry is a group of exogamous kins within a community; that is, no member of a group of kins (or phratry) could marry another person belonging to the same phratry. The evidence that this is or was the case in the Western tribe of Torres Straits is strong, but it is not absolutely proven.

In Yam, as in the other islands, there is at least one *kwod*, or taboo ground, where sacred ceremonies were held. In the principal *kwod* in Yam there was formerly a low fence surrounding a space about thirty-five feet square in which were the shrines of the two great totems of the island. All that now remains is several heaps of great Fusus shells.

Two of the heaps are about twenty-five feet in length. Formerly at the southerly end of each long row of shells was a large turtle-shell (tortoise-shell) mask representing respectively a crocodile and a hammer-headed shark. These were decorated in various ways, and under each was a stone in which the life of the totem resided; stretching from the front end of each mask was a cord to which numerous human lower jaw-bones were fastened, and its other end was attached to a human skull, which rested on a stone. Beside the shrine of the hammer-headed shark was a small heap of shells which was the shrine of a sea-snake, which was supposed to have originated from the shark. These shrines were formerly covered over by long low huts, which like the fence were decorated with large Fusus shells.

Outside the fence were two heaps of shells which had a mystical connection with the shrine; they were called the "navels of the totems."

I have referred to the *intichiuma* ceremonies of the Arunta tribe of Central Australia as being magical rites undertaken by certain kinsmen for the multiplication of the totems. In some cases, apparently, the ceremonies may take place wherever the men happen to be camping; in other cases there are definite localities where they must be performed, as there are in these places certain stones, rocks or trees which are intimately connected with the magical rites. These spots may be spoken of as shrines. In the island of Mabuiag the magical ceremony for the alluring of the dugong was performed by the men of that kin in their own *kwod*, which was a fixed spot; and doubtless this was the case in the other islands of Torres Straits, for even in the small islands there was a tendency to a territorial grouping of the kins. This localisation of a totem cult has proceeded one step further in Yam Island. Here we have a dual synthesis. The chief totem of each group of kins is practically alone recognised; in other words, the various lesser totems are being absorbed by two more important totems. Each totem has a distinct shrine, and the totem itself, instead of being a whole species, is visualised in the form of a representation of an individual animal, and this image was spoken of as the totem (*augud*). Indeed, the tendency to concretism had gone so far that the life of the *augud* was supposed to reside in the stone that lay beneath the image,[1] and certain heaps of shells were the navels of the totems, a further linkage of the totem to that spot of ground.

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[1] Baldwin Spencer and F. J. Gillen, "The Native Tribes of Central Australia," 1899; *cf.* also J. G. Frazer, *Fortnightly Review*, 1899, pp. 648, 835.

[2] "Folk-lore," xii. 1901, p. 230, and "Report Camb. Anthrop. Expedition to Torres Straits," vol. v. (in the press).

[3] *Loc. cit.*, 1899, p. 657.

[4] *Loc. cit.*, pp. 73, 167.

[5] I am fully aware that this appears to cut the ground from under my suggestion; but the latter deals with incipient totemism, and I do not see why the totem taboo should not have arisen from several causes.

A suggestion as to the significance of this transformation is not lacking. There are various folk-tales concerning a family of brothers who wandered from west to east across Torres Straits. Some of them were, in a mysterious way, sharks as well as men. The two brothers who went to Yam were called Sigai and Maiau, and each became associated, in his animal form, with one of the two phratries. The shrines in the *kwod* were so sacred that no women might visit them, nor did the women know what the totems were like. They were aware of Sigai and Maiau, but they did not know that the former was the hammer-headed shark and the latter was the crocodile; this mystery was too sacred to be imparted to the uninitiated. When the totems were addressed it was always by their hero names, and not by their animal or totem names.

Malu, another of these brothers, introduced the cult that bears his name to the Murray Islanders, who form part of the Eastern tribe. He also was identified with a hammer-headed shark. Totemism, as such, had practically disappeared from Murray Island before the advent of the white man, and the great ceremonies at the initiation of the lads into the Malu fraternity were a main feature of the religion of these people.

In Yam totemism was merging into a hero cult; in Murray Island the transformation was accomplished; the one had replaced the other.

In Mabuiag, one of the Western Islands, there was a local hero named Kwoiam whose deeds are narrated in a prose epic. Kwoiam made two crescentic ornaments of turtle-shell, which blazed with light when he wore them at night-time, and which he nourished with the savour of cooked fish. These ornaments were called totems (*augud*)—presumably because the natives did not know by what other sacred name to call them—and they became the insignia of the two groups of kins of Mabuiag. The crescent which was worn above Kwoiam's mouth was regarded as the more important, and those kins which had land animals for their totems were called from it "the children of the great totem," but the water group was called "the children of the little totem." There is reason to believe that the dual grouping of the kins is ancient. The erecting Kwoiam's emblems as the head totems of the two groups of kins must be comparatively recent. Here, again, the primitive association of a group of men with a group of natural objects obtains in the small groups or totem-kins, but in the larger synthesis a manufactured object replaces a group of animals, and this object possesses definite magical powers. There were two navel-shrines connected with the cult of Kwoiam, which were constructed to show that the two *augud* were born there. When it was deemed necessary to fortify the *augud*—that is, the emblems—they were placed on their respective navel-shrines. Further, in Muralug and the adjacent islands Kwoiam himself was a totem (*augud*). Thus in the westernmost islands of the Western tribe the transition from totemism to hero-worship was in process of evolution till it was arrested by the coming of the white man.

To what was this transformation due? It is not very easy to answer this question. We have evidence that in comparatively recent times a change took place in the social organisation of the people, and that the former matriarchal conditions had been replaced by patriarchal. Although superficially the marriage system of the Western tribe appears to be regulated by totemism, Dr. Rivers has found[2] that it is really a relationship system, and that descent, rather than totemism, is the regulating factor. The Eastern tribe, as represented by the Murray Islanders, had progressed further along this road than had the Western tribe. Such a change as this could not fail to have a disturbing effect upon other old customs.

The folk-tales that I collected clearly indicate a migration of culture from New Guinea to the Western tribe, and from the Western tribe to the Eastern tribe. I believe I can demonstrate the migration from New Guinea of a somewhat broad-headed people that spread over the Western Islands but barely reached Murray Island. It is conceivable that the culture myths have reference to this migration, and that the gradual substitution of a hero cult for totemism may be part of the same movement; but, on the other hand, this social and religious change is most thorough in Murray Island, where, I imagine, the racial movement has been least felt. The isolation of Murray Island from outside disturbing factors is very complete, and, being but a small island, a change once started might take place both rapidly and effectively.

It is interesting to note that the totem heroes of the Western tribe were invoked when their votaries were preparing to go to war. I obtained the following prayer in Yam Island:—"O *Augud* Sigai and O *Augud* Maiau, both of you close the eyes of those men so that they cannot see us," which had for its intent the slaughtering of the enemy without their being able to make a defence. I was informed that when the Yam warriors were fighting they would also call on the name of Kwoiam, who belonged to another group of islands, and on Yadzebub, a local warrior. Yadzebub was always described as a "man," whereas Kwoiam and Sigai were relegated to a "long time" back. From the folk-tales it is evident that Sigai and Maiau are more mythical or mysterious than Kwoiam. We thus have an instructive series: Yadzebub, the local famous man; Kwoiam, the hero, who was also a totem to other people; and Sigai and Maiau, the local totem heroes whose cult was visualised in turtle-shell images, and the life of each of whom resided in a particular stone. Perhaps it would be more correct to speak of this as the grafting of a new cult on totemism rather than to describe it as an evolution of totemism. A transformation has certainly occurred, but it does not appear to me to be a gradual growth—a metamorphosis in the natural history sense of the term—so much as the pouring of new wine into old bottles.

I hope on another occasion to deal with the question of religious and secret societies, as the growth of these has invariably disintegrated whatever antecedent totemism there may have been.

It is highly probable that something like what was taking place in Torres Straits has occurred elsewhere, but I cannot now enter into a comparative study of the rise of hero cults.

Local or Village Exogamy.

I have more than once ("Folk-lore," xii. 1901, p. 233; "Head-hunters, Black, White, and Brown," 1901, p. 258) called attention to the fact that among some Papuans marriage restrictions are territorial and not totemic. Dr. Rivers (*Journ.* Anthrop. Inst., xxx. 1900, p. 78) has shown that in Murray Island, Eastern tribe of Torres Straits, marriages are regulated by the places to which natives belong. A man cannot marry a woman of his own village or of certain other villages. The totemic system which probably at one time existed in this island appears to have been replaced by what may be called a territorial system. A similar custom occurs in the Mekeo district of British New Guinea, and it is probably still more widely distributed.

I was informed by a member of the Yaraikanna tribe of Cape York, North Queensland, that children must take the "land" or "country" of their mother; all who belong to the same place are brothers and sisters, a wife must be taken from another "country" ("Brit. Assoc. Report," Dover, 1899, p. 585); thus it appears their marriage restrictions are territorial and not totemic. The same is found amongst the Kurnai and the Coast Murring tribe in New South Wales (Frazer, "Totemism," p. 90).

At Kiwai, in the delta of the Fly River, B.N.G., all the members of a totemic group live together in a long house which is confined to that group. I have also collected evidence which proves there was a territorial grouping of totemic clans among the Western tribe of Torres Straits ("Reports Camb. Anthrop. Expedition to Torres Straits," v. in the press).

Within a comparatively small area we have the following conditions:—

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[1] For the keeping of a soul in an external receptacle, and for Dr. Frazer's views on its bearing on totemism, *cf. Fortnightly Review*, May, 1899, p. 844; "The Golden Bough," iii. 1900, pp. 418–422; and S. A. Cook, *Jewish Quart. Review*, 1902, p. 34 of reprint.

[2] "Reports Camb. Anthrop. Expedition to Torres Straits," v. "Kinship" (in the press).

(1) A typical totemic community with totem-kin houses (Kiwai).

(2) A typical totemic community with territorial grouping of the kins. Although there is totem exogamy, the marriage restrictions are regulated by relationship. The former mother-right has comparatively recently been replaced by father-right, but there are many survivals from matriarchy (Western tribe, Torres Straits).

(3) A community in which totemism has practically lapsed, with village exogamy and marriage restrictions regulated by relationship, patriarchy with survivals from matriarchy (Eastern tribe, Torres Straits).

(4) Total absence of totemism (?), village exogamy (Mekeo).

I do not assert this is a natural sequence, but it looks like one, and it appears to indicate another of the ways out of totemism. It is suggestive that this order also indicates the application of the several peoples to agriculture: the people of Kiwai are semi-nomadic, those of the Mekeo district are firmly attached to the land. This constraint of the soil must have operated in a similar manner elsewhere (*cf.* "L'Année Sociologique," v. 1902, pp. 330, 333). The territorial exogamy occasionally found in Australia cannot be explained as being due to agriculture; a rigid limitation of hunting grounds may here have had a similar effect.

In offering these remarks to-day I desire, above all, to impress on you the need there is for more work in the field. When one surveys the fairly extensive literature of totemism one is struck with the very general insufficiency of the evidence; as a matter of fact, full and precise information is lamentably lacking. The foundations upon which students at home have to build their superstructures of generalisation and theory are usually of too slight a character to support these erections with much chance of their permanence. There is only one remedy for this, and that is more extensive and more thorough field work. The problems connected with totemism bear upon many of the most important phases in the social and religious evolution of man, the solution of which can only be obtained within the space of a few years. The delay of each year in the investigation of primitive peoples means that so much less information is possible to be obtained. There is no exaggeration in this. Those who have a practical experience of backward man and who have travelled in out-of-the-way places can testify as to the surprising rapidity with which the old order changeth. In sober earnestness I appeal to all those who are interested in the history and character of man, whether they be theologians, historians, sociologists, psychologists or anthropologists, to face the plain fact that the only available data for the solution of many problems of the highest interest are daily slipping away beyond recovery.

SECTION I.

PHYSIOLOGY.

OPENING ADDRESS BY W. D. HALLIBURTON, M.D., F.R.S., PROFESSOR OF PHYSIOLOGY IN KING'S COLLEGE, LONDON, PRESIDENT OF THE SECTION.

The Present Position of Chemical Physiology.

AN engineer who desires to thoroughly understand how a machine works must necessarily know its construction. If the machine becomes erratic in its action, and he wishes to put it into proper working order, a preliminary acquaintance with its normal structure and function is an obvious necessity.

If we apply this to the more delicate machinery of the animal body, we at once see how a knowledge of function (physiology and pathology) is impossible without a preliminary acquaintance with structure or anatomy.

It is therefore not surprising, it is indeed in the nature of things, that physiology originated with the great anatomists of the past. It was not until Vesalius and Harvey by tedious dissections laid bare the broad facts of structure that any theorising concerning the uses of the constituent organs of the body had any firm foundation.

Important and essential as the knowledge is that can be revealed by the scalpel, the introduction and use of the microscope furnished physiologists with a still more valuable instrument. By it much that was before unseen came into view, and microscopic anatomy and physiology grew in stature and knowledge simultaneously.

The weapons in the armoury of the modern physiologist are multitudinous in number and complex in construction, and enable him in the experimental investigation of his subject to accurately measure and record the workings of the different parts of the machinery he has to study. But preeminent among these instruments stands the test-tube and the chemical operations typified by that simple piece of glass.

Herein one sees at once a striking distinction between the mechanism of a living animal and that of a machine like a steam engine or a watch. It is quite possible to be an excellent watchmaker or to drive a steam engine intelligently without any chemical knowledge of the various metals that enter into its composition. In order to set the mechanism right if it goes wrong, all the preliminary knowledge which is necessary is of an anatomical nature. The parts of which an engine is composed are stable; the oil that lubricates it and the fuel that feeds it never become integral parts of the machinery. But with the living engine all this is different. The parts of which it is made take up the nutriment or fuel and assimilate it, thus building up new living substance to replace that which is destroyed in the wear and tear associated with activity. This condition of unstable chemical equilibrium is usually designated metabolism, and metabolism is the great and essential attribute of a living as compared with a non-living thing.

It seems childish at the present day, and before such an audience as this, to point out how essential it is to know the chemical structure as well as the anatomical structure of the component parts of the body. But the early anatomists to whom I have alluded had no conception of the connection of the two sciences. Speaking of Vesalius, Sir Michael Foster says: "The great anatomist would no doubt have made use of his bitterest sarcasms had someone assured him that the fantastic school which was busy with occult secrets and had hopes of turning dross into gold would one day join hands in the investigation of the problems of life with the exact and clear anatomy so dear to him." Nor did Harvey, any more than Vesalius, pay heed to chemical learning. The scientific men of his time ignored and despised the beginning of that chemical knowledge which in later years was to become one of the foundations of physiology and the mainstay of the art of medicine.

The earliest to recognise this important connection was one whose name is usually associated more with charlatanry than with truth, namely, Paracelsus, and fifty years after the death of that remarkable and curious personality his doctrines were extended and developed by van Helmont. In spite, however, of van Helmont's remarkable insight into the processes of digestion and fermentation, his work was marred by the mysticism of the day, which called in the aid of supernatural agencies to explain what could not otherwise be fully comprehended.

In the two hundred and fifty years that have intervened between the death of van Helmont and the present day, alchemy became a more and more exact science and changed its name to chemistry, and a few striking names stand out of men who were able to take the new facts of chemistry and apply them to physiological uses. Of these one may mention Mayow, Lower, Boerhaave, Réaumur, Borelli, Spallanzani and Lavoisier. Mulder in Holland and Liebig in Germany bring us almost to the present time, and I think they may be said to share the honour of being regarded as the fathers of modern chemical physiology. This branch of science was first placed on a firm basis by Wöhler when he showed that organic compounds can be built out of their elements in the laboratory, and his first successful experiments in connection with the comparatively simple substance urea have been followed by numberless others, which have made organic chemistry the vast subject it is to-day.

Sir Michael Foster's book on the History of Physiology, from which I have already quoted, treats of the older workers who laid the foundations of our science, and whose names I have not done much more than barely mention. Those interested in the giants of the past should consult it. But what I propose to take up this morning is the work of those who have during more recent days been engaged in the later stages of the building. The edifice is far from completion even now. It is one of the charms of physiological endeavour that, as the older areas yield their secrets to the explorers, new ones are opened out which require equally careful investigation.

If even a superficial survey of modern physiological literature is taken, one is at once struck with the great preponderance of papers and books which have a chemical bearing. In this the physiological journals of to-day contrast very markedly with those of thirty, twenty, or even ten years ago. The sister science of chemical pathology is making similar rapid strides. In some universities the importance of biological chemistry is recognised by the foundation of chairs which deal with that subject alone; and though in the United Kingdom, owing mainly to lack of funds, this aspect of the advance of science is not very evident, there are signs that the date cannot be far distant when every well-equipped university or university college will follow the example set us at many seats of learning on the Continent and at Liverpool.

With these introductory remarks let me now proceed to describe what appear to me to be the main features of chemical physiology at the present time.

The first point to which I shall direct your attention is the rapid way in which chemical physiology is becoming an exact science. Though it is less than twenty years since I began to teach physiology, I can remember perfectly well a time when those who devoted their work to the chemical side of the science might almost be counted on the fingers of one hand, and when chemists looked with scarcely veiled contempt on what was at that time called physiological chemistry; they stated that physiologists dealt with messes or impure materials, and therefore anything in the nature of correct knowledge was not possible. There was a good deal of truth in these statements, and if physiologists to-day cannot quite say that they have changed all that, they can at any rate assert with truth that they are changing it. This is due to a growing *rapprochement* between chemists and physiologists. Many of our younger physiologists now go through a thorough preliminary chemical training; and on the other hand there is a growing number of chemists—of whom Emil Fischer may be taken as a type—who are beginning to recognise the importance of a systematic study of substances of physiological interest. A very striking instance of this is seen in the progress of our knowledge of the carbohydrates, which has culminated in the actual synthesis of several members of the sugar group. Another instance is seen in the accurate information we now possess of the constitution of uric acid. When Miescher began his work on the chemical composition of the nuclei of cells, and separated from them the material he called nuclein, he little foresaw the wide practical application of his work. We now know that it is in the metabolism of cell-nuclei that we have to look for the oxidative formation of uric acid and other substances of the purine family. Already the chemical relationships of uric acid and nuclein have taught practical physicians some of the secrets that underlie the occurrence of gout and allied disorders.

With the time at my disposal, it would be impossible to discuss all the chemico-vital problems which the physiologists of the present day are attempting to solve, but there is one subject at which many of them are labouring which seems to me to be of supreme importance—I mean the chemical constitution of proteid or albuminous substances. Proteids are produced only in the living laboratory of plants and animals; proteid metabolism is the main chemical attribute of a living thing; proteid matter is the all-important material present in protoplasm. But in spite of the overwhelming importance of the subject, chemists and physiologists alike have far too long fought shy of attempting to unravel the constitution of the proteid molecule. This molecule is the most complex that is known; it always contains five, and often six, or even seven elements. The task of thoroughly understanding its composition is necessarily vast, and advance slow. But little by little the puzzle is being solved, and this final conquest of organic chemistry, when it does arrive, will furnish physiologists with new light on many of the dark places of physiological science.

The revival of the vitalistic conception in physiological work appears to me a retrograde step. To explain anything we are not fully able to understand in the light of physics and chemistry by labelling it as vital or something we can never hope to understand is a confession of ignorance, and, what is still more harmful, a bar to progress. It may be that there is a special force in living things that distinguishes them from the inorganic world. If this is so, the laws that regulate this force must be discovered and measured, and I have no doubt that those laws when discovered will be found to be as immutable and regular as the force of gravitation. I am, however, hopeful that the scientific workers of the future will discover that this so-called vital force is due to certain physical or chemical properties of living matter which have not yet been brought into line with the known chemical and physical laws that operate in the inorganic world, but which as our knowledge of chemistry and physics increases will ultimately be found to be subservient to such laws.

Let me take as an example the subject of osmosis. The laws which regulate this phenomenon through dead membranes are fairly well known and can be experimentally verified; but in the living body there is some other manifestation of force which operates in such a way as to neutralise the known force of osmosis. Is it necessary to suppose that this force is a new one? May it not rather be that our much vaunted knowledge of osmosis is not yet complete? It is quite easy to understand why a dead and a living membrane should behave differently in relation to substances that are passing through them. The molecules of the dead membrane are, comparatively speaking, passive and stable; the molecules in a membrane made of living cells are in a constant state of chemical integration and disintegration; they are the most unstable molecules we know. Is it to be expected that such molecules would allow water, or substances dissolved in water, to pass between them and remain entirely inactive? The probability appears to me to be all the other way; the substances passing, or attempting to pass, between the molecules will be called upon to participate in the chemical activities of the molecules themselves, and in the building up and breaking down of the compounds so formed there will be a transformation of chemical energy and a liberation of what looks like a new force. Before a physicist decides that his knowledge of osmosis is final, let him attempt to make a membrane of some material which is in a state of unstable chemical equilibrium, a state in some way comparable to what is called metabolism in living protoplasm. I cannot conceive that such a task is insuperable, and when accomplished, and the behaviour of such a membrane in an osmometer or dialyser is studied, I am convinced that we shall find that the laws of osmosis as formulated for such dead substances as we have hitherto used will be found to require revision.

Such an attitude in reference to vital problems appears to be infinitely preferable to that which too many adopt of passive content, saying the phenomenon is vital and there is an end of it.

When a scientific man says this or that vital phenomenon cannot be explained by the laws of chemistry and physics, and therefore must be regulated by laws of some other nature, he most unjustifiably assumes that the laws of chemistry and physics have all been discovered. He forgets, for instance, that such an important detail as the constitution of the proteid molecule has still to be made out.

The recent history of science gives an emphatic denial to such a supposition. All my listeners have within the last few years seen the discovery of the Röntgen rays and the modern development of wireless telegraphy. On the chemical side we have witnessed the discovery of new elements in the atmosphere and the introduction of an entirely new branch of chemistry called physical chemistry. With such examples ready to our hands, who can say what further discoveries will not shortly be made, even in such well-worked fields as chemistry and physics?

The mention of physical chemistry brings me to what I may term the second head of my discourse, the second striking characteristic of modern chemical physiology; this is the increasing importance which physiologists recognise in a study of inorganic chemistry. The materials of which our bodies are composed are mainly organic compounds, among which the proteids stand out as preeminently important; but everyone knows there are many substances of the mineral or inorganic kingdom present in addition. I need hardly mention the importance of water, of the oxygen of the air, and of salts like sodium chloride and calcium phosphate.

The new branch of inorganic chemistry called physical chemistry has given us entirely new ideas of the nature of solutions, and the fact that electrolytes in solution are broken up into their constituent ions is one of fundamental importance. One of the many physiological aspects of this subject is seen in a study of the action of mineral salts in solution on living organisms and parts of organisms. Many years ago Dr. Ringer showed that contractile tissues (heart, cilia, &c.) continue to manifest their activity in certain saline solutions. Howell goes so far as to say, and probably correctly say, that the cause of the rhythmical action of the heart is the presence of these inorganic substances in the blood or lymph which usually bathes it. The subject has more recently been taken up by Loeb and his colleagues at Chicago; they confirm Ringer's original statements, but interpret them now as ionic action. Contractile tissues will not contract in pure solutions of non-electrolytes like sugar or albumin. But different contractile tissues differ in the nature of the ions which are their most favourable stimuli. An optimum salt solution is one in which stimulating ions, like those of sodium, are mixed with a certain small amount of those which like calcium restrain activity. Loeb considers that the ions act because they affect either the physical condition of the colloidal substances (proteid, &c.) in protoplasm or the rapidity of chemical processes.

Amœboid movement, ciliary movement, the contraction of muscle, cell division and karyokinesis all fall into the same category as being mainly dependent on the stimulating action of ions.

Loeb has even gone so far as to consider that the process of fertilisation is mainly ionic action; he denies that the nuclein of the male cell is essential, but asserts that all it does is to act as the stimulus in the due adjustment of the proportions of the surrounding ions, and supports this view by numerous experiments on ova in which without the presence of spermatozoa he has produced larvæ by merely altering the saline constituents and so the osmotic pressure of the fluid that surrounds them. Whether such a sweeping and almost revolutionary notion will stand the test of further verification must be left to the future; so also must the equally important idea that nervous impulses are to be mainly explained on an electrolytic basis. But whether or not all the details of such work will stand the test of time, the experiments I have briefly alluded to are sufficient to show the importance of physical chemistry to the physiologist, and they also form a useful commentary on what I was saying just now about vitalism. Such eminently vital phenomena as movement and fertilisation are to be explained in whole or in part as due to the physical action of inorganic substances. Are not such suggestions indications of the undesirability of postulating the existence of any special mystic vital force?

I have spoken up to this point of physical chemistry as a branch of inorganic chemistry; there are already indications of its importance also in relation to organic chemistry. Many eminent chemists consider that the future advance of organic chemistry will be on the new physical lines. It is impossible to forecast where this will lead us; suffice it to say that not only physiology, but also pathology, pharmacology and even therapeutics will receive new accessions to knowledge the importance of which will be enormous.

I have now briefly sketched what appear to me to be the two main features of the chemical physiology of to-day, and the two lines, organic and inorganic, along which I believe it will progress in the future.

Let me now press upon you the importance in physiology, as in all experimental sciences, of the necessity first of bold experimentation, and secondly of bold theorising from experimental data. Without experiment all theorising is futile; the discovery of gravitation would never have seen the light if laborious years of work had not convinced Newton that it could be deduced from his observations. The Darwinian theory was similarly based upon data and experiments which occupied the greater part of its author's lifetime to collect and perform. Pasteur in France and Virchow in Germany supply other instances of the same devotion to work which was followed by the promulgation of wide-sweeping generalisations.

And after all it is the general law which is the main object of research; isolated facts may be interesting and are often of value, but it is not until facts are correlated and the discoverers ascertain their inter-relationships that anything of epoch-making importance is given to the world.

It is, however, frequently the case that a thinker with keen insight can see the general law even before the facts upon which it rests are fully worked out. Often such bold theorisers are right, but even if they ultimately turn out to be wrong, or only partly right, they have given to their fellows some general idea on which to work; if the general idea is incorrect, it is important to prove it to be so in order to discover what is right later on. No one has ever seen an atom or a molecule, yet who can doubt that the atomic theory is the sheet anchor of chemistry? Mendeléeff formulated his periodic law before many of the elements were discovered; yet the accuracy of this great generalisation has been such that it has actually led to the discovery of some of the missing elements.

I purpose to illustrate these general remarks by a brief allusion to two typical sets of researches carried out during recent years in the region of chemical physiology. I do not pretend that either of them has the same overwhelming importance as the great discoveries I have alluded to, but I am inclined to think that one of them comes very near to that standard. The investigations in question are those of Ehrlich and of Pawlow. The work of Ehrlich mainly illustrates the useful part played by bold theorising, the work of Pawlow that played by the introduction of new and bold methods of experiment.

I will take Pawlow first. This energetic and original Russian physiologist has by his new methods succeeded in throwing an entirely new light on the processes of digestion. Ingeniously devised surgical operations have enabled him to obtain the various digestive juices in a state of absolute purity and in large quantity. Their composition and their actions on the various foodstuffs have thus been ascertained in a manner never before accomplished; an apparently unfailing resourcefulness in devising and adapting experimental methods has enabled him and his fellow workers to discover the paths of the various nerve impulses by which secretion in the alimentary canal is regulated and controlled. The importance of the psychical element in the process of digestion has been experimentally verified. If I were asked to point out what I considered to be the most important outcome of all this painstaking work, I should begin my answer by a number of negatives, and would say, not the discovery of the secretory nerves of the stomach or pancreas; not the correct analysis of the gastric juice, nor the fact that the intestinal juice has most useful digestive functions; all of these are discoveries of which anyone might have been rightly proud; but after all they are more or less isolated facts. The main thing that Pawlow has shown is that digestion is not a succession of isolated acts, but each one is related to its predecessor and to that which follows it; the process of digestion is thus a continuous whole; for example, the acidity of the gastric juice provides for a delivery of pancreatic juice in proper quantity into the intestine; the intestinal juice acts upon the pancreatic, and so enables the latter to perform its powerful actions. I am afraid this example, as I have tersely stated it, presents the subject rather inadequately, but it will serve to show what I mean. Further, the composition of the various juices is admirably adjusted to the needs of the organism; when there is much proteid to be digested, the proteolytic activity of the juices secreted is correspondingly high, and the same is true for the other constituents of the food. It is such general conclusions as these, the correlation of isolated facts leading to the formulation of the law that the digestive process is continuous in the sense I have indicated, and adapted to the needs of the work to be done, that constitute the great value of the work from the Russian laboratory. Work of this sort is sure to stimulate others to fill in the gaps and complete the picture, and already has borne fruit in this direction. It has, for instance, in Starling's hands led to the discovery of a chemical stimulus to pancreatic secretion. This is formed in the intestine as the result of the action of the gastric acid, and taken by the blood-stream to the pancreas. Whether this *secretin* as it is called may be one of a group of similar chemical stimuli which operate in other parts of the body has still to be found out.

The other series of researches to which I referred are those of Ehrlich and his colleagues and followers on the subject of immunity. This subject is one of such importance to every one of us that I am inclined to place the discovery on a level with those great discoveries of natural laws to which I alluded at the outset of this portion of my Address. I hesitate to do so yet because many of the details of the theory still await verification. But up to the present all is working in that direction, and Ehrlich's ideas illustrate the value of bold theorising in the hands of clear-sighted and far-seeing individuals.

But when I say that the doctrine is bold, I do not mean to infer that the experimental facts are scanty; they are just the reverse. But in the same way that a chemist has never seen an atom, and yet he believes atoms exist, so no one has yet ever seen a toxin or antitoxin in a state of purity, and yet we know they exist, and this knowledge promises to be of incalculable benefit to suffering humanity.

It may not be uninteresting to state briefly, for the benefit of those to whom the subject is new, the main facts and an outline of the theory which is based upon them.

We are all aware that one attack of many infective maladies protects us against another attack of the same disease. The person is said to be *immune* either partially or completely against that disease. Vaccination produces in a patient an attack of cow-pox or vaccinia. This disease is related to small-pox, and some still hold that it is small-pox modified and rendered less malignant by passing through the body of a calf. At any rate, an attack of vaccinia renders a person immune to small-pox, or variola, for a certain number of years. Vaccination is an instance of what is called *protective inoculation*, which is now practised with more or less success in reference to other diseases like plague and typhoid fever. The study of immunity has also rendered possible what may be called *curative inoculation*, or the injection of antitoxic material as a cure for diphtheria, tetanus, snake poisoning, &c.

The power the blood possesses of slaying bacteria was first discovered when the effort was made to grow various kinds of bacteria in it; it was looked upon as probable that blood would prove a suitable soil or medium for this purpose. It was found in some instances to have exactly the opposite effect. The chemical characters of the substances which kill the bacteria are not fully known; indeed, the same is true for most of the substances we have to speak of in this connection. Absence of knowledge on this particular point has not, however, prevented important discoveries from being made.

So far as is known at present, the substances in question are proteid in nature. The bactericidal powers of blood are destroyed by heating it for an hour to 56° C. Whether the substances are enzymes is a disputed point. So also is the question whether they are derived from the leucocytes; the balance of evidence appears to me to be in favour of this view in many cases at any rate, and phagocytosis becomes more intelligible if this view is accepted. The substances, whatever be their source or their chemical nature, are sometimes called alexins, but the more usual name now applied to them is that of *bacteriolysins*.

Closely allied to the bactericidal power of blood, or blood-serum, is its globulicidal power. By this one means that the blood-serum of one animal has the power of dissolving the red blood-corpuscles of another species. If the serum of one animal is injected into the blood-stream of an animal of another species, the result is a destruction of its red corpuscles, which may be so excessive as to lead to the passing of the liberated hæmoglobin into the urine (hæmoglobinuria). The substance or substances in the serum that possess this property are called *haemolysins*, and though there is some doubt whether bacteriolysins and hæmolysins are absolutely identical, there is no doubt that they are closely related substances.

Another interesting chemical point in this connection is the fact that the bactericidal power of the blood is closely related to its alkalinity. Increase of alkalinity means increase of bactericidal power. Venous blood contains more diffusible alkali than arterial blood and is more bactericidal; dropsical effusions are more alkaline than normal lymph and kill bacteria more easily. In a condition like diabetes, when the blood is less alkaline than it should be, the susceptibility to infectious diseases is increased. Alkalinity is probably beneficial because it favours those oxidative processes in the cells of the body which are so essential for the maintenance of healthy life.

Normal blood possesses a certain amount of substances which are inimical to the life of our bacterial foes. But suppose a person gets run down; everyone knows he is then liable to "catch anything." This coincides with a diminution in the bactericidal power of his blood. But even a perfectly healthy person has not an unlimited supply of bacteriolysin, and if the bacteria are sufficiently numerous he will fall a victim to the disease they produce. Here, however, comes in the remarkable part of the defence. In the struggle he will produce more and more bacteriolysin, and if he gets well it means that the bacteria are finally vanquished, and his blood remains rich in the particular bacteriolysin he has produced, and so will render him immune to further attacks from that particular species of bacterium. Every bacterium seems to cause the development of a specific bacteriolysin.

Immunity can more conveniently be produced gradually in animals, and this applies, not only to the bacteria, but also to the toxins they form. If, for instance, the bacilli which produce diphtheria are grown in a suitable medium, they produce the diphtheria poison, or toxin, much in the same way that yeast-cells will produce alcohol when grown in a solution of sugar. Diphtheria toxin is associated with a proteose, as is also the case with the poison of snake venon. If a certain small dose called a "lethal dose" is injected into a guinea-pig, the result is death. But if the guinea-pig receives a smaller dose it will recover; a few days after it will stand a rather larger dose; and this may be continued until after many successive gradually increasing doses it will finally stand an amount equal to many lethal doses without any ill effects. The gradual introduction of the toxin has called forth the production of an antitoxin. If this is done in the horse instead of the guinea-pig the production of antitoxin is still more marked, and the serum obtained from the blood of an immunised horse may be used for injecting into human beings suffering from diphtheria, and rapidly cures the disease. The two actions of the blood, antitoxic and antibacterial, are frequently associated, but may be entirely distinct.

The antitoxin is also a proteid probably of the nature of a globulin; at any rate, it is a proteid of larger molecular weight than a proteose. This suggests a practical point. In the case of snake-bite the poison gets into the blood rapidly owing to the comparative ease with which it diffuses, and so it is quickly carried all over the body. In treatment with the antitoxin or antivenin, speed is everything if life is to be saved; injection of this material under the skin is not much good, for the diffusion into the blood is too slow. It should be injected straight away into a blood-vessel.

There is no doubt that in these cases the antitoxin neutralises the toxin much in the same way that an acid neutralises an alkali. If the toxin and antitoxin are mixed in a test-tube and time allowed for the interaction to occur, the result is an innocuous mixture. The toxin, however, is merely neutralised, not destroyed; for if the mixture in the test-tube is heated to 68° C. the antitoxin is coagulated and destroyed and the toxin remains as poisonous as ever.

Immunity is distinguished into *active* and *passive*. Active immunity is produced by the development of protective substances in the body; passive immunity by the injection of a protective serum. Of the two the former is the more permanent.

Ricin, the poisonous proteid of castor-oil seeds, and *abrin*, that of the Jequirity bean, also produce when gradually given to animals an immunity, due to the production of antiricin and antiabrin respectively.

Ehrlich's hypothesis to explain such facts is usually spoken of as the *side-chain theory* of immunity. He considers that the toxins are capable of uniting with the protoplasm of living cells by possessing groups of atoms like those by which nutritive proteids are united to cells during normal assimilation. He terms these *haptophor* groups, and the groups to which these are attached in the cells he terms *receptor* groups. The introduction of a toxin stimulates an excessive production of receptors, which are finally thrown out into the circulation, and the free circulating receptors constitute the antitoxin. The comparison of the process to assimilation is justified by the fact that non-toxic substances like milk introduced gradually by successive doses into the blood-stream cause the formation of anti-substances capable of coagulating them.

Up to this point I have spoken only of the blood, but month by month workers are bringing forward evidence to show that other cells of the body may by similar measures be rendered capable of producing a corresponding protective mechanism.

One further development of the theory I must mention. At least two different substances are necessary to render a serum bactericidal or globulicidal. The bacteriolysin or hæmolysin consists of these two substances. One of these is called the *immune body*, the other the *complement*. We may illustrate the use of these terms by an example. The repeated injection of the blood of one animal (*e.g.* the goat) into the blood of another animal (*e.g.* a sheep) after a time renders the latter animal immune to further injections, and at the same time causes the production of a serum which dissolves readily the red blood-corpuscles of the first animal. The sheep's serum is thus hæmolytic towards goat's blood-corpuscles. This power is destroyed by heating to 56° C. for half an hour, but returns when fresh goat's serum is added. The specific immunising substance formed in the sheep is called the immune body; the ferment-like substance destroyed by heat is the complement. The latter is not specific, since it is furnished by the blood of non-immunised animals, but it is nevertheless essential for hæmolysis. Ehrlich believes that the immune body has two side groups—one which connects with the receptor of the red corpuscles and one which unites with the haptophor group of the complement, and thus renders possible the ferment-like action of the complement on the red corpuscles. Various antibacterial serums which have not been the success in treating disease they were expected to be are probably too poor in complement, though they may contain plenty of the immune body.

Quite distinct from the bactericidal, globulicidal and antitoxic properties of blood is its agglutinating action. This is another result of infection with many kinds of bacteria or their toxins. The blood acquires the property of rendering immobile and clumping together the specific bacteria used in the infection. The test applied to the blood in cases of typhoid fever, and generally called Widal's reaction, depends on this fact.

The substances that produce this effect are called *agglutinins*. They also are probably proteid-like in nature, but are more resistant to heat than the lysins. Prolonged heating to over 60° C. is necessary to destroy their activity.

Lastly, we come to a question which more directly appeals to the physiologist than the preceding, because experiments in relation to immunity have furnished us with what has hitherto been lacking, a means of distinguishing human blood from the blood of other animals.

The discovery was made by Tchistovitch (1899), and his original experiment was as follows :—Rabbits, dogs, goats and guinea-pigs were inoculated with eel-serum, which is toxic ; he thereby obtained from these animals an antitoxic serum. But the serum was not only antitoxic, but produced a precipitate when added to eel-serum, but not when added to the serum of any other animal. In other words, not only has a specific antitoxin been produced, but also a specific *precipitin*. Numerous observers have since found that this is a general rule throughout the animal kingdom, including man. If, for instance, a rabbit is treated with human blood, the serum ultimately obtained from the rabbit contains a specific precipitin for human blood ; that is to say, a precipitate is formed on adding such a rabbit's serum to human blood, but not when added to the blood of any other animal.[1] The great value of the test is its delicacy ; it will detect the specific blood when it is greatly diluted, after it has been dried for weeks, or even when it is mixed with the blood of other animals.

I have entered into this subject at some length, because it so admirably illustrates the kind of research which is now in progress ; it is also of interest to others than mere physiologists. I have not by any means exhausted the subject, but for fear I may exhaust my audience let me hasten to a conclusion. I began by eulogising the progress of the branch of science on which I have elected to speak to you. Let me conclude with a word of warning on the danger of over-specialisation. The ultra-specialist is apt to become narrow, to confine himself so closely to his own groove that he forgets to notice what is occurring in the parallel and intercrossing grooves of others. But those who devote themselves to the chemical side of physiology run but little danger of this evil. The subject cannot be studied apart from other branches of physiology, so closely are both branches and roots intertwined. As an illustration of this, may I be permitted to speak of some of my own work ? During the past few years the energies of my laboratory have been devoted to investigations on the chemical side of nervous activity, and I have had the advantage of cooperating to this end with a number of investigators, of whom I may particularly mention Dr. Mott and Dr. T. G. Brodie. But we soon found that any narrow investigation of the chemical properties of nervous matter and the changes this undergoes during life and after death was impossible. Our work extended in a pathological direction so as to investigate the matter in the brains of those suffering from nervous disease ; it extended in a histological direction so as to determine the chemical meaning of various staining reactions presented by normal and abnormal structures in the brain and spinal cord ; it extended in an experimental direction in the elucidation of the phenomena of fatigue, and to ascertain whether there was any difference in medullated and non-medullated nerve fibres in this respect ; it extended into what one may call a pharmacological direction in the investigation of the action of the poisonous products of the breakdown of nervous tissues. I think I have said enough to show you how intimate are the connections of the chemical with the other aspects of physiology, and although I have given you but one instance, that which is freshest to my mind, the same could be said for almost any other well-planned piece of research work of a bio-chemical nature.

We have now before us the real work of the Section, the reading, hearing and seeing the researches which will be brought forward by members of the Association, and I must, in thanking you for your attention, apologise for the length of time I have kept you from these more important matters.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is recommended by Mr. Herbert Welsh, of Philadelphia, who was largely instrumental in raising the Wilson endowment fund, value 100,000 dollars, of the Washington and Lee University, that a fund of 500,000 dollars be raised to endow a scientific and technical school for the University.

THE papers read at the conference of science teachers held at the Hartley University College, Southampton, to which attention was directed in our issue of June 19, 1902, have now been published in book form. The title of the little volume is "Science Teaching and Nature Study." Copies may be obtained from Mr. H. M. Gilbert, Above Bar, Southampton, price 6*d*. each.

THE following courses of lectures on advanced physiology are announced for delivery in the physiological laboratory at the buildings of the University of London during the coming term :—(*a*) "On the Sources of Animal Energy," by Prof. E. H. Starling, on Tuesdays, October 14, 21, 28, November 4, 11, 18, 25, December 2, at 5 p.m. ; (*b*) "On Animal Heat and Respiration," by Dr. M. S. Pembrey, on Wednesdays, October 15, 22, 29, November 5, 12, 19, 26, December 3, at 5 p.m. The lectures, admission to which is free, are addressed to advanced students, and are arranged to meet the requirements of candidates for honours in physiology at the University. Cards of admission may be obtained on application to the Academic Registrar, at the University Buildings, South Kensington, S.W.

SCIENTIFIC SERIALS.

Journal of Botany, September.—Under the title of "Alabastra diversa," Mr. Spencer le M. Moore continues his account of new plants. *Amphoranthus spinosus*, from Damaraland, furnishes a new genus of the suborder Cæsalpinieæ, approximating to the existing genus Cordyla. Five new species are added to the Acanthaceæ. A note by the same writer refers to the plant which, under the name of *Haemacanthus coccineus*, was described in a previous number of the *Journal* as a new genus ; there is some possibility of this proving to be identical with the plant named *Satanocrater coccineus* by Dr. Lindau.—Dr. Rendle describes two new varieties of orchids from China, and a new species of Burmannia from the same country. The latter is figured along with Amphoranthus.—Two papers deal with the genus Hieracium ; in the first, Mr. H. J. Riddelsdell gives a list of Welsh Hieracia ; in the second, Mr. F. N. Williams, in the course of his remarks on the "Salient Features in Hieracium," alludes to the difference between the characters emphasised by Scandinavian and Continental botanists, and points out the importance of the hairs, the structure of the receptacle and the stem branching as distinguishing morphological features.—Messrs. R. E. and F. Cundall contribute a list of Glamorganshire plants which furnishes a supplement to that published recently by Messrs. Marshall and Shoolbred.—The article entitled "Botany in England a Century Ago" gives the impressions of Dr. H. A. Noehden formed during his visit to this country in the year 1799.

The American Journal of Science, September.—The relationships of some American and Old World birches, by M. L. Fernald.—On the fertile fronds of Crossotheca and Myriotheca, and on the spores of other Carboniferous ferns from Mazon Creek, Illinois, by E. H. Sellards.—On the validity of *Idiophyllum rotundiflorum*, Lesquereux, a fossil plant from the Coal-measures of Mazon Creek, Illinois, by E. H. Sellards. It

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[1] There may be a slight reaction with the blood of allied animals ; for instance, with monkey's blood in the case of man.